The ground state of ^{193}Ir has a measured spin value of 3/2. The states 461 and 713 keV are fed by beta decay from ^{193}Os with ground state spin $3/2^-$. Thus the possible values of spin for these states are $1/2^+$, $3/2^+$, $5/2^+$ and $7/2^+$ to fit the first forbidden character of beta transitions. Spins of $1/2^+$ and $7/2^+$ are ruled out for the 461 keV state based on finite value of A_2 and $E2+M1$ character of the 461 keV transition respectively. The 252 keV transition is assumed to be $M1$ and the 461 keV is assumed to be $M1+E2$ with a mixing ratio ($E2/M1$) of 0·67 (Nablo *et al.*, 1958). For the possible spins of $1/2^+$, $3/2^+$, $5/2^+$ and $7/2^+$ for the 713 keV state and $3/2^+$ and $5/2^+$ for the 461 keV state and assuming the characters of the 252 and 461 keV transitions as outlined above, the theoretical values of the correlation coefficients are estimated for both signs of the mixing parameter ($E2/M1$) of the 461 keV transition. In all cases the values of A_4 are found to be vanishingly small. The value of A_2 corresponding to the spin sequence $5/2 \rightarrow 3/2 \rightarrow 3/2$ and a negative phase of the mixing parameter of the 461 keV transition (value of $A_2 = 0{\cdot}05$) is found to be the nearest to the present experimental value. It thus appears that the spins of the 713 and 461 keV states in ^{193}Ir are 5/2 and 3/2 respectively.

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THERMAL EXPANSION OF NICKEL FLUORIDE

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With a view to correlating the antiferromagnetic behaviour of the fluorides of iron, cobalt and nickel with the changes in their structure at the Neel tempera-

ture, Haefner (1964) determined their coefficients of thermal expansion by the x-ray method at low temperatures. As the thermal expansion data of these substances above the room temperature are not available, the authors recently studied the thermal behaviour of cobalt fluoride and iron fluoride in the temperature range 30°C to 600°C and obtained interesting results (Rao and Naidu, 1963; Rao *et al*, 1966). Hence it is thought worthwhile to determine the coefficients of thermal expansion of nickel fluoride also at elevated temperatures.

Using Unicam 19 cm high temperature powder camera, powder photographs were collected with CuK radiation from room temperature to 600°C. Nine reflections, recorded in the Bragg angle region 63° to 79°, were used to evaluate the accurate lattice parameters. The methods of evaluating the precision lattice parameters and the coefficients of thermal expansion have been described in an earlier paper (Rao *et al*, 1962).

The lattice parameters of nickel fluoride at different temperatures are shown in table 1. The coefficients of thermal expansion at different temperatures are shown graphically in figure 1. The temperature dependence of $\alpha_{\parallel}$ and $\alpha_{\perp}$ is represented by equations (1) and (2).

$$\alpha_{\parallel} = 8.825 \times 10^{-6} + 7.648 \times 10^{-9} t + 4.978 \times 10^{-12} t^2 \quad (1)$$

$$\alpha_{\perp} = 6.954 \times 10^{-6} + 8.463 \times 10^{-9} t + 1.097 \times 10^{-11} t^2 \quad (2)$$

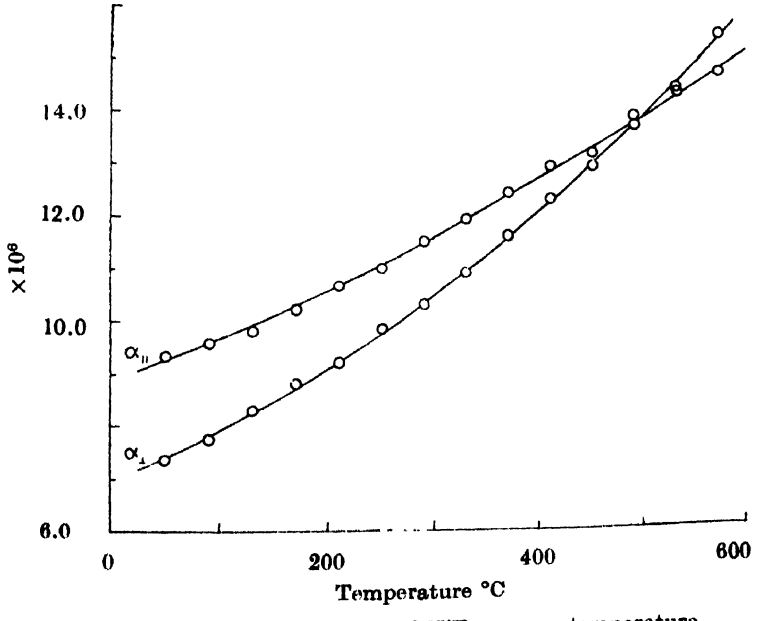

Figure 1. Coefficients of thermal expansion of NiF_2 versus temperature.

Table 1
Lattice parameters of NiF_2 at different temperatures

Temperature °C	a(Å)	c(Å)
28	4.6498	3.0838
70	4.6515	3.0842
161	4.6551	3.0870
210	4.6570	3.0891
258	4.6598	3.0904
306	4.6620	3.0921
354	4.6641	3.0935
401	4.6665	3.0958
449	4.6695	3.0976
497	4.6720	3.0994
534	4.6748	3.1009
571	4.6777	3.1033
608	4.6803	3.1046

It may be noted that though the value of $\alpha_{\parallel}$ is greater than $\alpha_{\perp}$ at room temperature, as in the case of many rutile type compounds, they are equal at 495°C and above this temperature $\alpha_{\perp}$ is greater than $\alpha_{\parallel}$. The values of $\alpha_{\parallel}$ and $\alpha_{\perp}$ obtained by Haefner (1964) at 17°C, 10.4×10^{-6} deg^{-1}and 8.0×10^{-6} deg^{-1} respectively are found to be slightly higher than the values 9.0×10^{-6} deg^{-1} and 7.1×10^{-6} deg^{-1} evaluated from equations 1 and 2.

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